Heterogeneity of long-history migration predicts emotion recognition accuracy

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Abstract

Recent work (Rychlowska et al., 2015) demonstrated the power of a relatively new cultural dimension, *historical heterogeneity*, in predicting cultural differences in the endorsement of emotion expression norms. Historical heterogeneity describes the number of source countries that have contributed to a country's present-day population over the last 500 years. People in cultures originating from a large number of source countries may have historically benefited from greater and clearer emotional expressivity, since they lacked a common language and well-established social norms. We therefore hypothesized that in addition to endorsing more expressive display rules, individuals from heterogeneous cultures will also produce facial expressions that are easier to recognize by people from other cultures. By re-analyzing cross-cultural emotion recognition data from 92 papers and 82 cultures, we show that emotion expressions of people from heterogeneous cultures are more easily recognized by observers from other cultures than are the expressions produced in homogeneous cultures. Heterogeneity influences expression recognition rates alongside the individualism-collectivism of the perceivers' culture, as more individualistic cultures were more accurate in emotion judgments than collectivistic cultures. This work reveals the present-day behavioral consequences of long-term historical migration patterns and demonstrates the predictive power of historical heterogeneity.

Keywords: historical heterogeneity, culture, emotional expression, individualism-collectivism

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Rychlowska and colleagues (2015) demonstrated that cultural display rules for the expression of emotion are influenced by *historical heterogeneity*, or the extent to which a country's present-day population derives from migration from numerous versus few source countries over the last 500 years (Putterman & Weil, 2010). Their analysis revealed that, even after controlling for other cultural dimensions such as individualism-collectivism (I-C) and residential mobility, higher heterogeneity (or long history migration from numerous source countries) predicts stronger endorsement of the rule that emotions should be openly expressed as felt. The extant findings demonstrate that historical heterogeneity predicts self-report measures of emotional expressiveness, and document its discriminant validity as compared to other cultural variables. Here we extend the utility of the currently underutilized heterogeneity construct and show that it predicts the extent to which facial expressions are recognizable to people from other cultures.

Although individuals can recognize facial expressions of emotion produced by people across cultures with a moderate degree of accuracy (e.g., Izard, 1994; cf. Russell, 1994), there is also variability in emotional expression across cultures due to display rules (Matsumoto, 1990) and emotional dialects (Elfenbein, Beaupré, Lévesque, & Hess, 2007). In a meta-analysis of cross-cultural emotion recognition studies, Elfenbein and Ambady (2002) found an in-group advantage, such that people were better at recognizing the expressions of members of their own culture compared to others. They proposed that cultures develop dialects in nonverbal emotion expression much in the way languages diverge over time (Elfenbein, 2013). While the emotion dialect theory posits that some cross-cultural variation is due to random differences in expressive tendencies and norms, some emotion dialects may have a functional foundation.

We propose that waves of migration from many countries of origin will exert pressure on the expressivity and clarity of emotion expressions, which over time is incorporated into a particular culture's emotion dialect. Individuals in historically heterogeneous societies, such as Brazil and the United States, are predicted to produce more universally recognizable expressions of emotions than people in homogeneous societies like Japan and Ethiopia. We reason that substantial long-history migration (heterogeneity) not only blurs the differences between in-groups and out-groups, but also forces interactions between same-status individuals coming from traditions with different emotion cultures and vocabularies. In a social context in which people need to both cooperate and compete without sharing common language or common social norms, the use of non-verbal emotional cues in communication should be enhanced (see also Schug, Matsumoto, Horita, Yamagishi, & Bonnet, 2010). This may result in norms for more intense, and therefore more recognizable, expressions (Hess, Blairy, & Kleck, 1997). In contrast, cultures with stable and homogeneous populations share common values, norms, and language. Over centuries, people from these cultures could rely to a greater extent on shared expectations and context to infer emotions of others. Historical heterogeneity is thus conceptually related to residential mobility (Oishi, 2010) in that it forces interactions between strangers. Heterogeneity, however, operates over long periods of time, potentially influencing cultural systems (Cohen, 2010) and values.

Historical heterogeneity is a particularly tractable cultural dimension because it represents a specific, quantifiable demographic construct. It is not based on averaged responses from previous samples and has no corresponding individual-level construct, unlike I-C, rendering it less vulnerable to ecological fallacy issues (see Brewer & Venaik, 2014). Historical heterogeneity, like other distal causes of cultural variation (e.g., Fincher, Thornhill, Murray, &

Schaller, 2008; Talhelm, Zhang, Oishi, Shimin, Duan, Lan, & Kitayama, 2014), is expected to predict a wide variety of institutional-, interpersonal-, and individual-level cultural differences in addition to emotion expressions.

Here we re-analyzed emotion accuracy data from a collection of cross-cultural studies to test the prediction that expressions produced by people from historically heterogeneous countries are more cross-culturally recognizable than the expressions of people from homogeneous countries. We also tested – although without prior hypotheses –whether the heterogeneity of the perceivers' country affects their ability to decode emotion expressions displayed by members of other cultures. We included I-C in some analyses because of its value as a predictor of emotional expressivity (Matsumoto et al., 2008). Heterogeneity is moderately correlated with I-C (Rychlowska et al., 2015), possibly because people who choose to immigrate and contribute to the heterogeneity of a country tend to endorse individualistic values, and voluntary settlement is related to individualism (Kitayama, Ishii, Imada, Takemura, & Ramaswamy, 2006). Also, newly settled heterogeneous societies may initially lack the hierarchical and role-based systems that help sustain collectivistic orientations (Yamagishi & Suzuki, 2009). Given this moderate overlap between heterogeneity and I-C, we tested the unique contribution of heterogeneity when controlling for I-C.

Method

We analyzed data from studies that used explicit judgments or categorizations of facial, bodily, and/or vocal expressions of emotion, and were located by referring to Elfenbein and Ambady's (2002) meta-analysis of cross-cultural emotion recognition. The list was updated to include more recent published and unpublished studies. We matched averaged emotion recognition scores with historical heterogeneity (Putterman & Weil, 2010) and I-C (Hofstede,

2001) scores of the perceivers' (i.e., study participants) and expressers' (i.e. people displaying the emotion expressions) countries of origin.

Literature search

Studies prior to 2002. The primary source for studies was the meta-analysis of cross-cultural emotion recognition by Elfenbein and Ambady (2002). The researchers found studies by searching volumes of relevant journals and a variety of online databases (using the terms *culture, ethnicity, in-group, out-group,* or *nation,* along with *emotion* or *nonverbal*), and by soliciting unpublished data. Here, we excluded cross-cultural judgments involving two native-born subcultures not linguistically or geographically isolated from one another (e.g., Caucasian Americans and African Americans). This left us with 145 separate cross-cultural judgments from 68 papers.

Studies included in the original meta-analysis measured cross-cultural emotion recognition using an objective indicator of accuracy, typically in the form of a forced-choice emotion categorization task. While most studies identified the cultures at the national level (e.g. "Germany"), others compared ethnic, regional, or racial subcultures (e.g. "West Indian Canadian"). The authors excluded clinical populations, although data from healthy control groups qualified for inclusion. The stimuli used in the studies included dynamic and static facial, vocal, or full-body expressions of emotion, produced either spontaneously or intentionally.

Studies after 2002. Using the same keywords as Elfenbein and Ambady (2002), we searched Google Scholar for potentially relevant studies published in the year 2002 or after and solicited unpublished data using psychology email groups and forums. The search returned 24 relevant papers with 67 average cross-cultural emotion judgment scores. For one study (Elfenbein, 2006) that involved emotion recognition training and testing periods, we only

included accuracy scores from the training blocks. Another study (Zhang, Parmley, Wan, & Cavanagh, 2015) measured emotion recognition at several levels of expression intensity, but we only included accuracy scores for the "moderate" intensity level. Combined with studies included in Elfenbein and Ambady (2002), the current dataset comprised 212 cross-cultural emotion recognition scores from 92 papers, with participants from 79 cultures and expressions from 32 cultures (for a complete list, see supplementary materials https://osf.io/smfb5/?view_only=40456c058c6e433f8722f5cb5964a68d).

Calculating cross-cultural emotion recognition accuracy. Studies in which participants selected a label for a facial expression from 4 options are expected to report higher raw accuracy scores than studies where 10 emotion label options were provided. Elfenbein & Ambady (2002) therefore corrected the accuracy scores based on the number of options participants were given (proportion correct – (1/number of choices))/(1-(1/number of choices)) (Nunnally & Bernstein, 1994). For instance, if the average accuracy in a forced-choice task with 4 options for a given sample were 70%, the corrected accuracy score would be 60%, (.7-(1/4))/(1-(1/4)). Unless the papers published after 2002 already reported unbiased accuracy scores, we applied the same formula to them.

Culture-level predictors

Historical heterogeneity. To quantify heterogeneity of long-history migration patterns, economists Putterman and Weil (2010) used genetic information supplemented by textual accounts and traced the origins of the present-day populations for 165 countries (see Figure 1). They estimated the proportion of each country's current population that descended from people living in other countries in the year 1500 A.D., resulting in a World Migration Matrix (available online at www.econ.brown.edu/fac/louis_putterman/world%20migration%20matrix.htm). Our

indicator of historical heterogeneity was the total number of source countries that contributed to a country's population over the last 500 years (*Min* = 1, e.g. Japan; *Max* = 83, United States). We assigned a score of 1 to indigenous populations that were sampled specifically because of their cultural isolation, such as the Fore of New Guinea (given the shortcomings of this assumption, in our online materials we report analyses excluding these samples, which did not alter our conclusions). No heterogeneity score was available for French Canada.

Individualism-Collectivism. Hofstede's (2001) I-C scores describe the characteristics of an ideal work place (e.g. security, challenging tasks) rated by employees of a multinational company in 50 different countries. Higher values indicate greater endorsement of individualistic, rather than collectivistic, values (*Min* = 2, *Max* = 91). This specific measure explains significant unique variance in self-reported emotional expressivity across cultures and is only moderately correlated with historical heterogeneity (r = .551; Rychlowska et al., 2015). Scores of I-C were unavailable for 8 cultures (Alaskan Indians, Bolivia, Burkina Faso, Canadian Cree, Ethiopia, Khyrgyzstan, Namibia, Zambia).

Some studies included in our analyses report data from multiple cultures together, either because the participants were from multiple cultures or because expressions from multiple countries were presented as stimuli. In these cases we averaged the culture-level variable scores for the countries represented in the sample. For instance, a British and Italian sample (Gallois & Callan, 1986) was assigned the average of the two countries' Heterogeneity (15) and I-C (82.5) scores.

Results

Analyses were conducted in the R environment (R Core Team, 2015; all package versions used were from April 2015 or earlier) using the lme4 (Bates, Maechler, Bolker, &

Walker, 2014) and lmerTest (Kuznetsova, 2015) packages. Supplemental analyses and the complete data are available online (https://osf.io/smfb5/?view_only=40456c058c6e433f8722f5cb5964a68d).

We hypothesized that Expresser Heterogeneity would predict cross-cultural emotion recognition accuracy such that individuals from heterogeneous cultures would produce expressions that were better recognized by people from other cultures. We used linear mixed-effect modeling with random intercepts for Perceiver and Expresser culture and Study (we also report results from non-hierarchical linear regressions in the online materials).

We first regressed emotion recognition accuracy scores on Perceiver and Expresser Heterogeneity. As predicted, Expresser Heterogeneity was positively related to emotion recognition, with more heterogeneous expressers producing more recognizable expressions, b = 0.147, SE = 0.035, $t(177.40) = 4.18$, $p < .001$ (see Figure 2). Perceiver Heterogeneity, however, only trended towards explaining a significant amount of variance in emotion recognition accuracy, b = .070, SE = .039, $t(143.16) = 1.79$, p=.076.

When we added Hofstede I-C scores for Perceiver and Expresser, Expresser Heterogeneity remained a significant predictor, b = 0.145, SE = 0.060, $t(184.59) = 2.43$, p = .02. Perceiver I-C significantly predicted accuracy, such that the more individualistic the Perceiver culture, the greater their emotion recognition accuracy, b = 0.137, SE=.042, $t(140.43) = 3.24$, $p <$. 01. Neither the effect of Perceiver Heterogeneity nor the effect of Expresser I-C approached significance, $|t|$'s < .81, p's > .43.

Finally, we ran a model to check whether the effect of Expresser Heterogeneity remained when controlling for the way in which the emotion stimuli were acquired. Using a modified version of Elfenbein and Ambady's (2002) coding system, we dichotomously coded whether a)

experimenters explicitly instructed expressers on how to make an expression or b) simply asked them to express a particular emotion or used naturally-occurring expressions. Instructed expressions were better recognized, $b = 14.436$, $SE = 3.254$, $t(171.49) = 4.44$, $p < .001$, but Expresser Heterogeneity remained a significant predictor, $b = .087$, $SE = .038$, $t(161.25) = 2.28$, $p = .024$.[1]

In sum, the more source countries contributed to a culture's present-day population, the more accurately expressions from this culture were recognized by people from other countries. Furthermore, controlling for heterogeneity, people from more individualistic cultures are more accurate cross-cultural perceivers of emotion expressions.

Discussion

We re-analyzed the results of 92 studies reporting a total of 212 average cross-cultural emotion recognition scores to test the hypothesis that people from historically heterogeneous cultures produce facial expressions of emotion that are recognized more accurately than expressions produced by people from homogeneous cultures. Our analyses provide support for that hypothesis, extending the previous findings on the construct of historical heterogeneity (Rychlowska et al., 2015). The effect of historical heterogeneity persisted even when we controlled for whether researchers coached expressers on how to make particular facial expressions or not. This suggests that cultural variation in clarity or intensity of expression persists regardless of intentionality of the displays (cf. Kang & Lau, 2013).

At first glance the positive relationship between expresser heterogeneity and emotion

[1] In this analysis Perceiver Heterogeneity emerged as a significant predictor, $b = .090$, $SE = .040$, $t(127.98) = 2.25$, $p = .027$. Given the unstability of this predictor in the present work, future investigation is warranted and we will not focus on Perceiver Heterogeneity in the discussion. Nonetheless, the possibility that people from heterogeneous cultures process expressions differently, and more regularly encounter highly expressive nonverbal signals, fits logically with the current hypotheses.

recognition accuracy may seem to conflict with evidence (e.g., Matsumoto, 1992) that people from collectivistic and homogeneous East Asian cultures (e.g., Japan) demonstrate decreased emotion recognition accuracy when looking at expressions of individualistic and heterogeneous cultures (e.g. United States). Based on these previously-documented effects, one may expect that heterogeneous expressions are not reliably easier to decode than homogeneous ones. However, we suggest that the effects of perceiver I-C and expresser heterogeneity are additive: East Asian and other collectivistic perceivers may generally show reduced cross-cultural emotion recognition accuracy (Matsumoto, 1992), but based on the current findings, their decreased performance may be exacerbated if they are judging the expressions of other homogeneous cultures compared to the expressions of heterogeneous cultures. Indeed, we found that perceivers' culture-level scores for individualism-collectivism predict variance in cross-cultural emotion recognition accuracy: on average, people from more individualistic cultures recognized the expressions of other cultures better than people from more collectivistic cultures.

While the present analysis demonstrates the relevance of historical factors in emotion research, future research needs to investigate the exact mechanisms by which long-term migration patterns affect emotion processing. A potentially relevant moderator of the relationship between emotion expressivity and heterogeneity is the degree to which different subcultures in a country had regular, cooperative contact with each other. Historical heterogeneity is a promising cultural dimension that, along with other factors such as I-C, may help predict the cross-cultural recognizability of emotion expression dialects.

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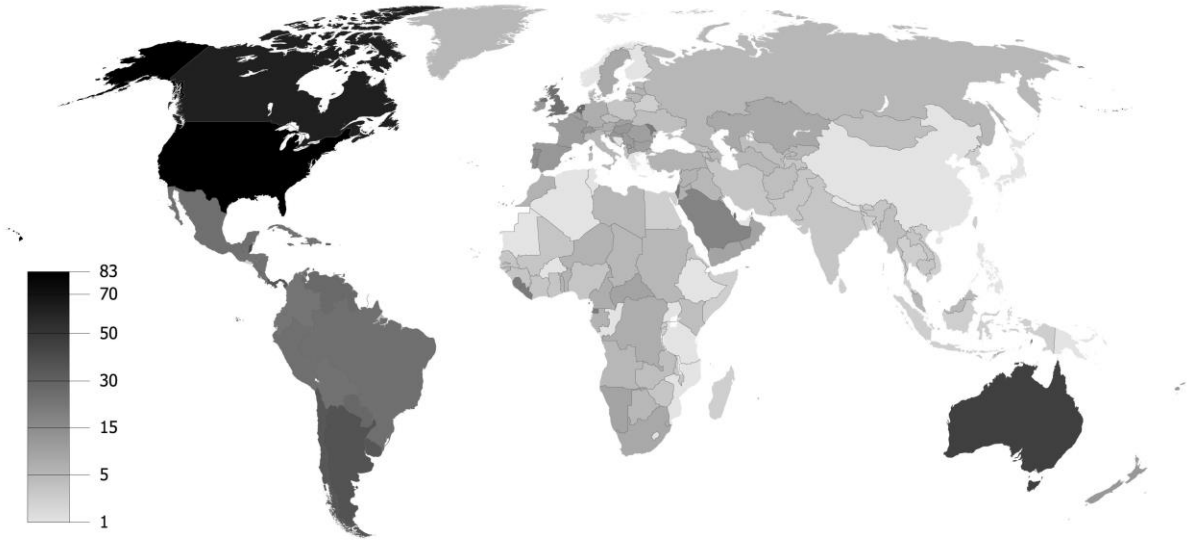


Figure 1. Map of historical heterogeneity. Darker countries are more heterogeneous, meaning their present-day populations originate from a greater number of source countries (values on legend refer to number of source countries). Map generated at http://gunn.co.nz/map and based on data from World Migration Matrix (www.econ.brown.edu/fac/louis_putterman/world%20migration%20matrix.htm).

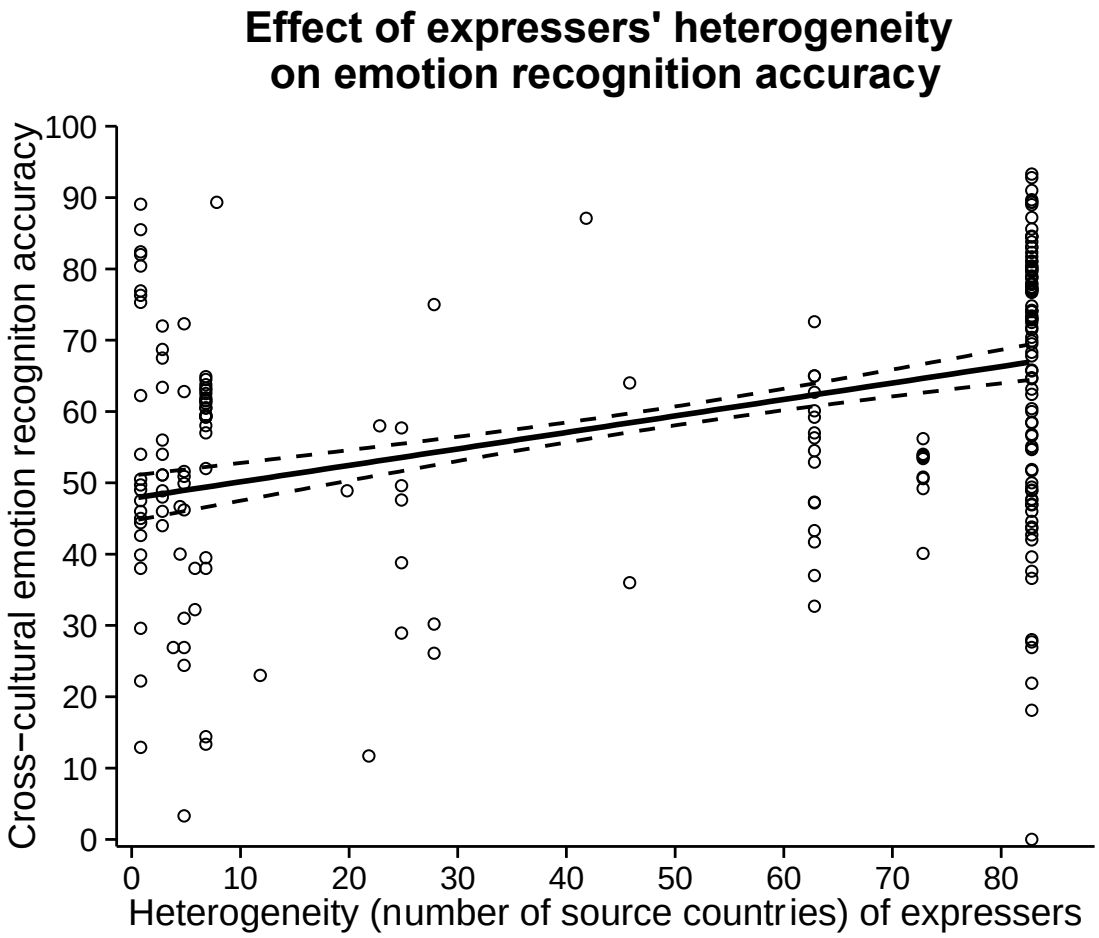


Figure 2. The effect of expresser culture's heterogeneity on cross-cultural emotion recognition accuracy. Data points represent raw data (not aggregated by culture), while the solid line refers to the linear regression estimate controlling for perceiver heterogeneity, as well as expresser and perceiver Hofstede I-C. Error bands refer to +/- 1 standard error of the linear model estimate.

Figure 1 (Map)

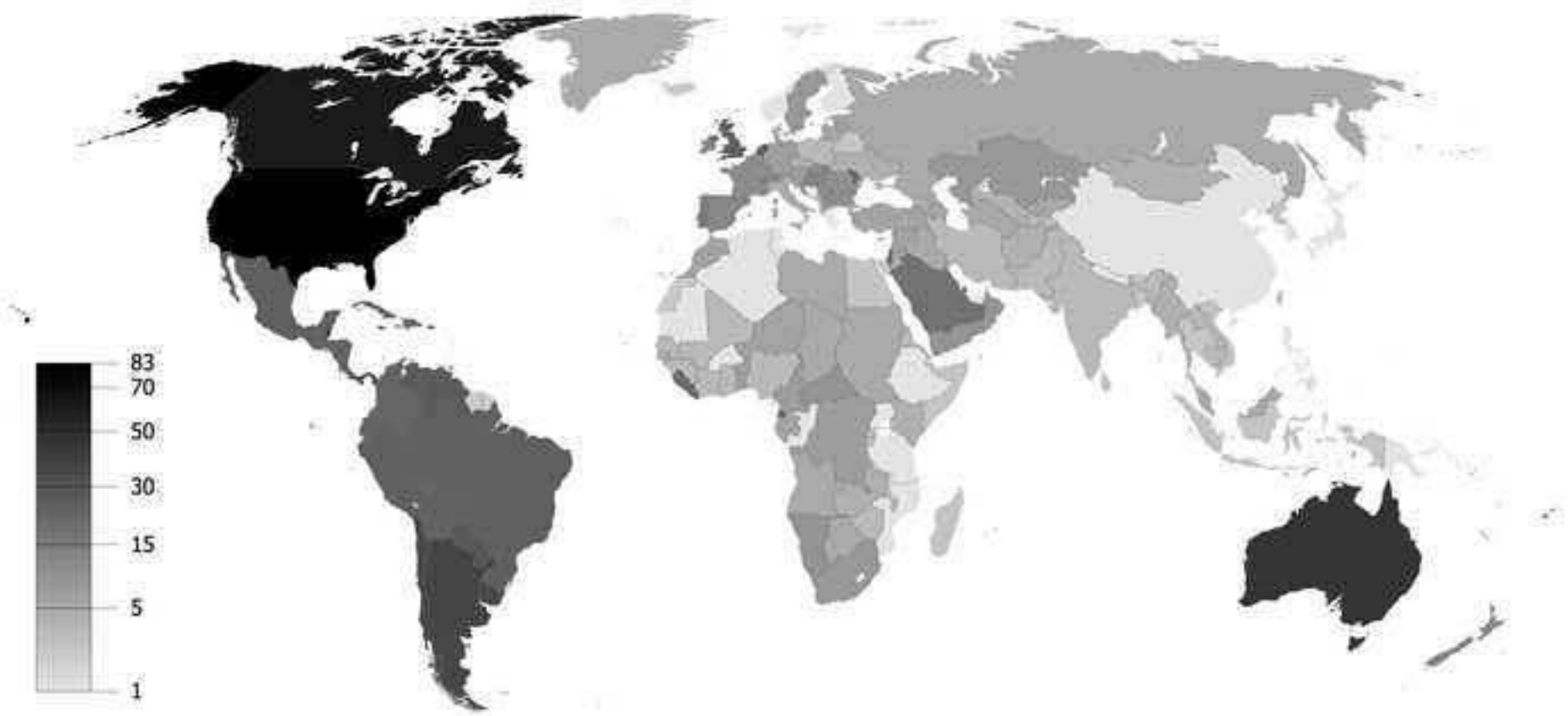
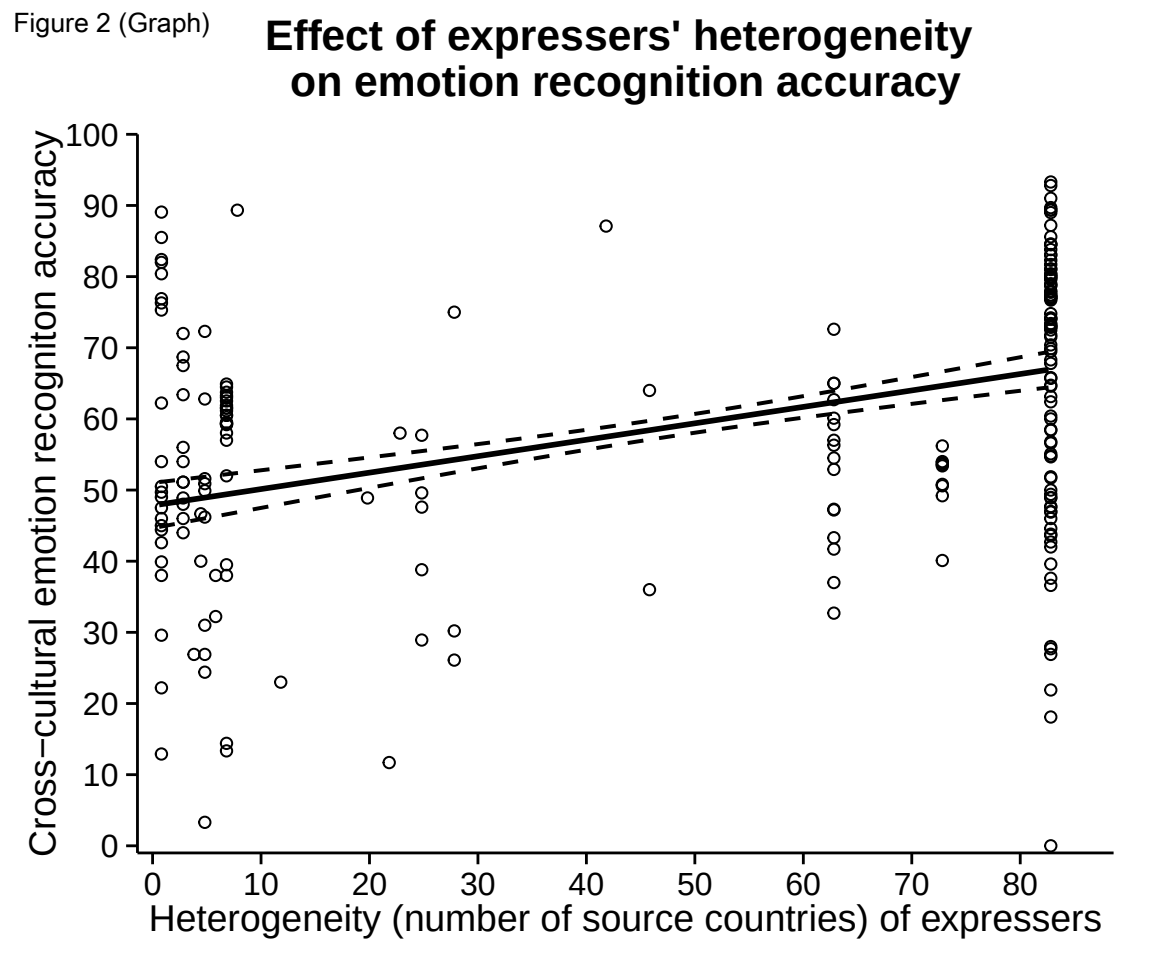


Figure 2 (Graph)



Data and R analysis script

Click here to download Supplemental Material - Additional: data_analyses_sept3_emotion.zip

Full list of studies used

Click here to download Supplemental Material - Integral: supplementary_references_pub.docx